ADT PLM

Programmer's Learning Machine

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IJD Seminar, 2016-02-02

Outline

1. Presentation of PLM
   - Purposes
   - Demo
   - About PLM
   - Architecture
2. User's code's assessment
   - Challenges
   - Extraction of the execution component
   - Docker
3. Result
4. Next steps

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Presentation of PLM

Purposes

- Application to learn programming.

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Presentation of PLM

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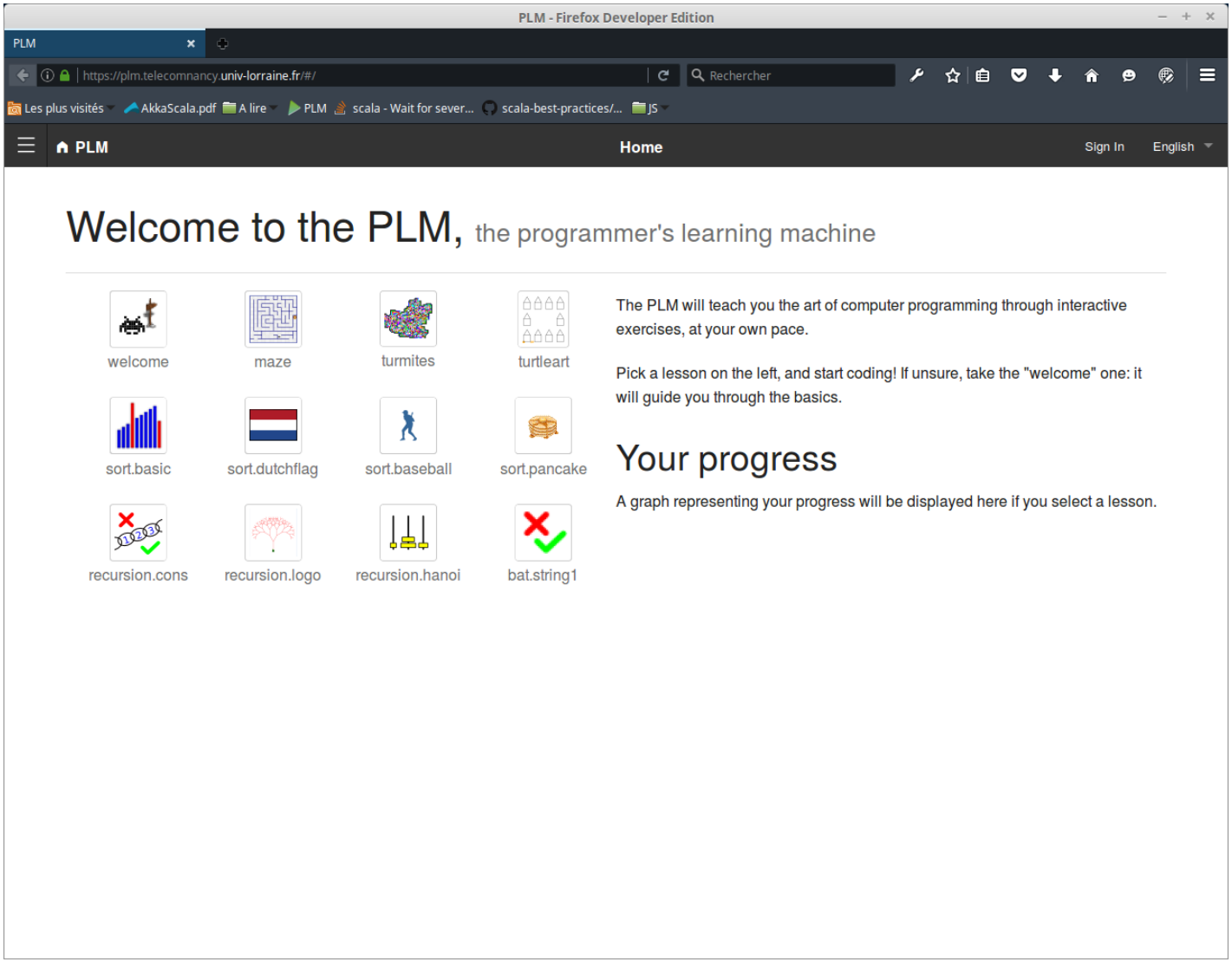
- Application to learn programming.
- Allows students to progress at their own speed...
- ... while the teacher helps the ones having trouble.
- Used at TELECOM Nancy since 2008.

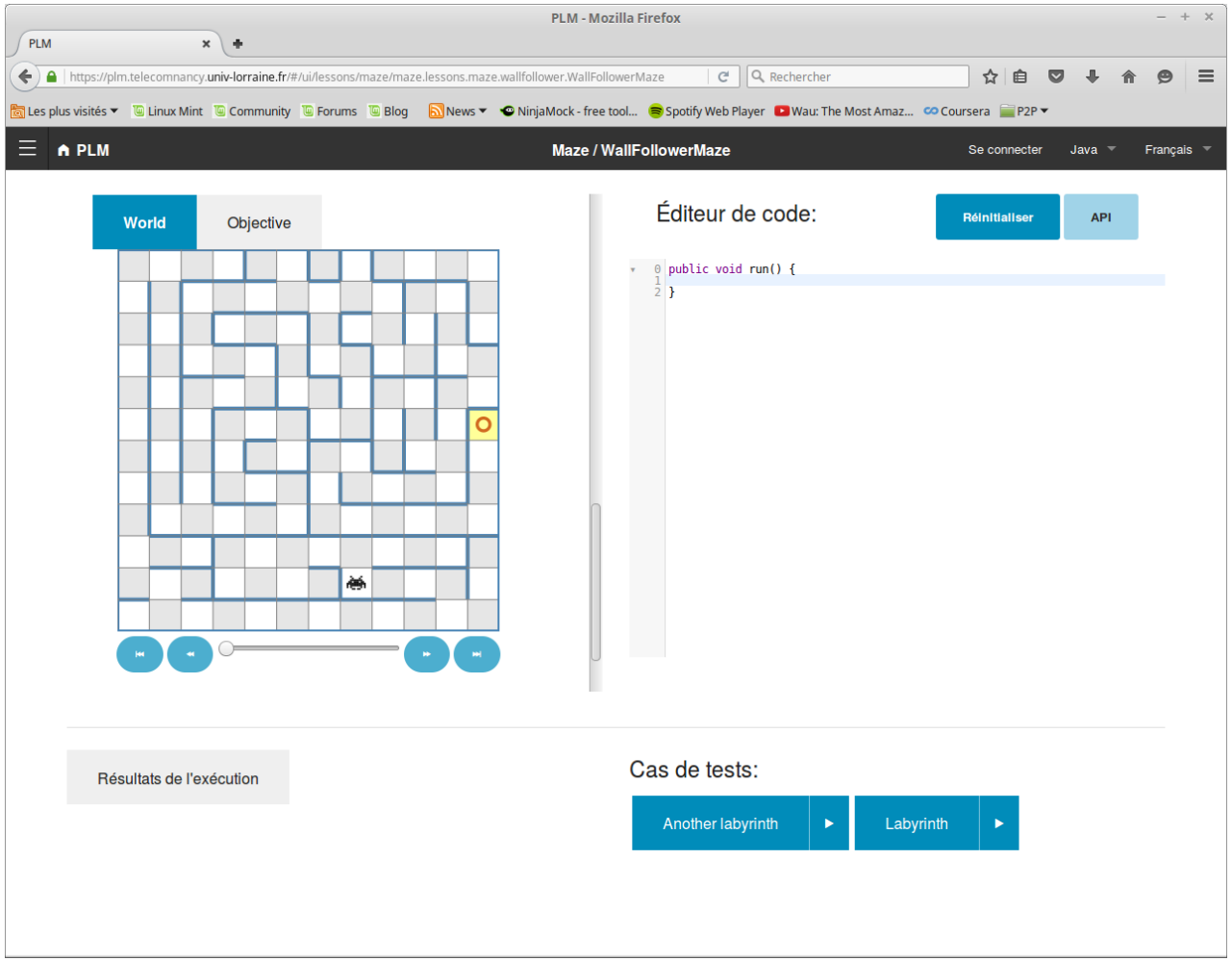
Presentation of PLM

Quick demo



Presentation of PLM

12 lessons, 200 exercises



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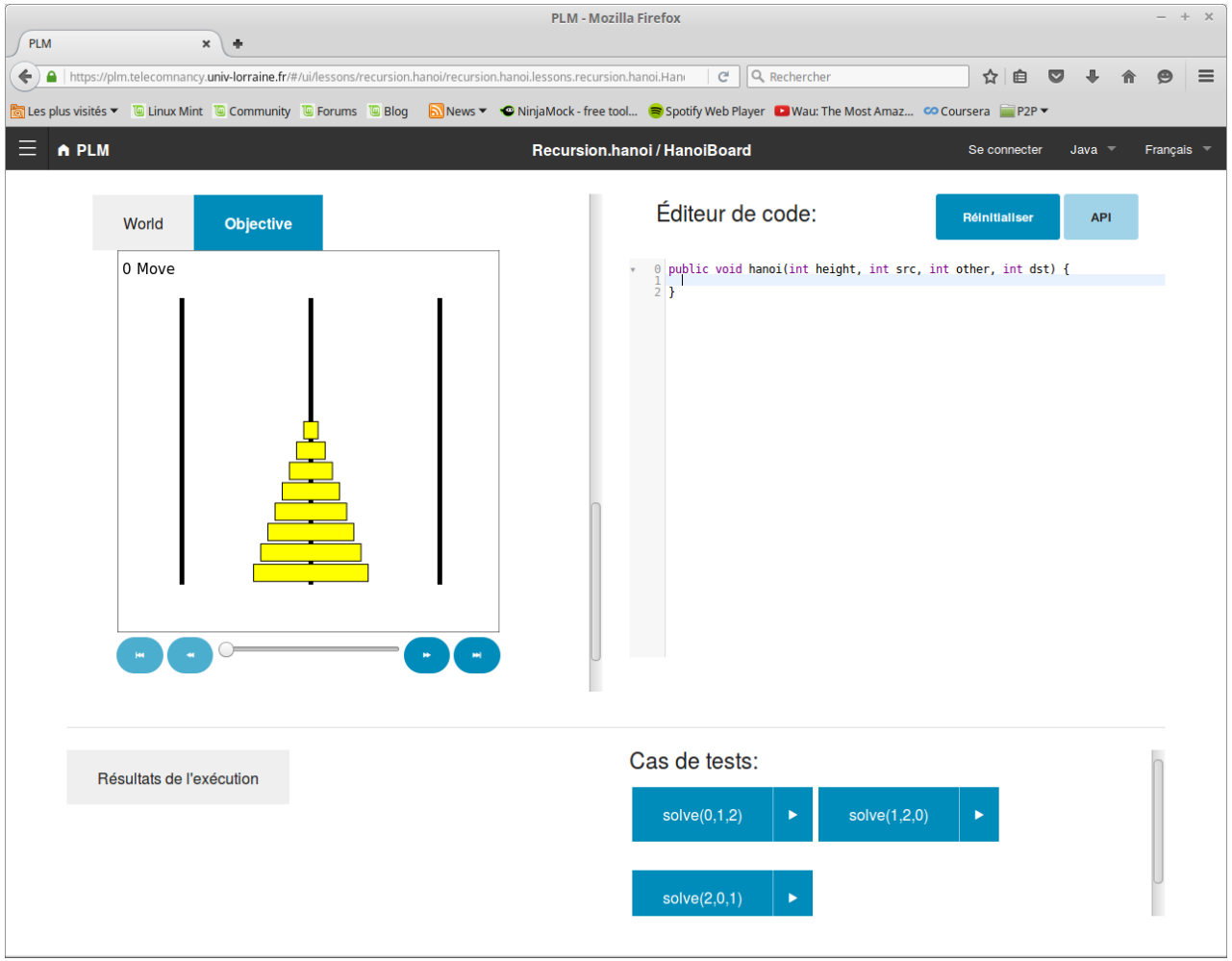

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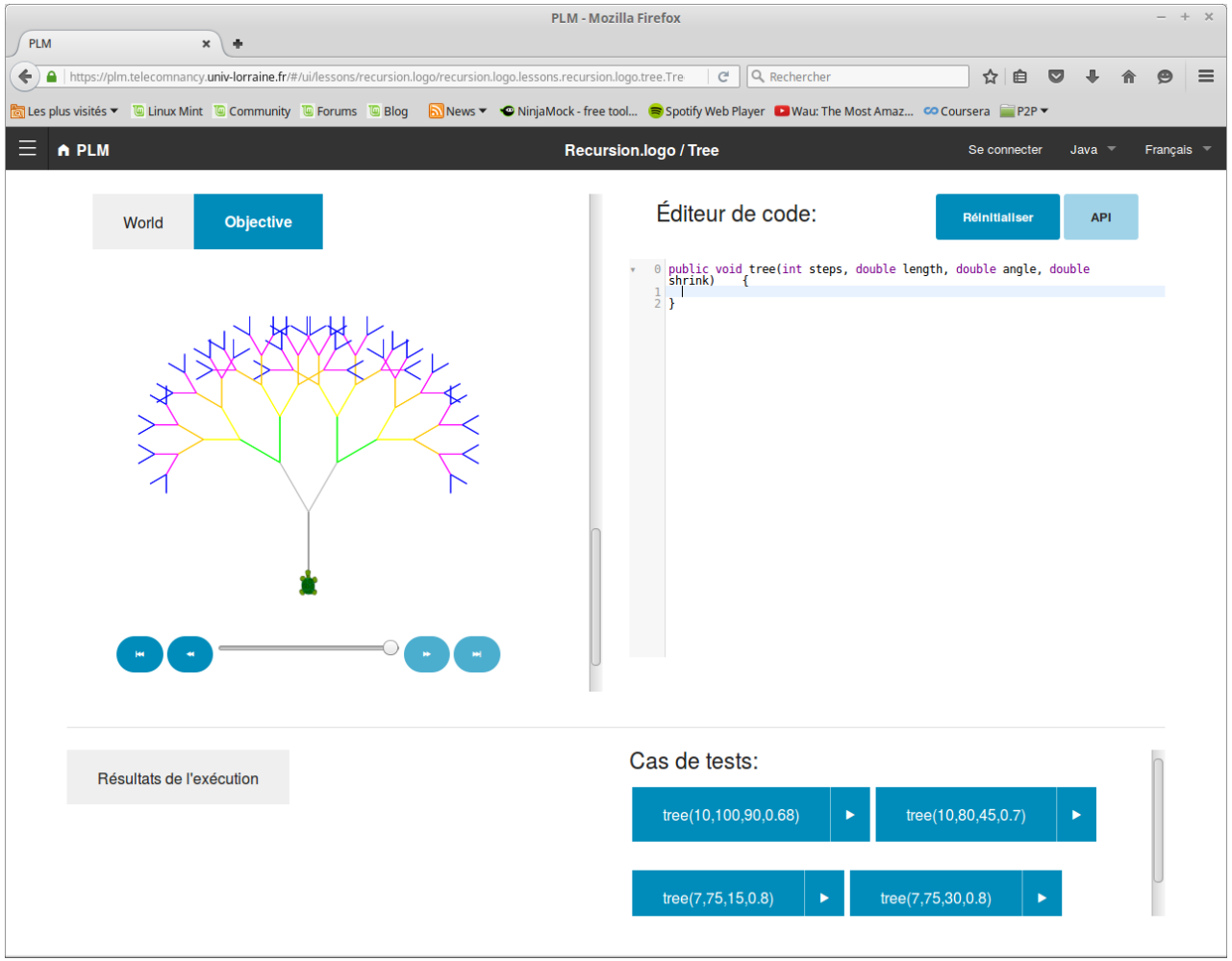

Presentation of PLM

Supported languages

- English
- French
- Brazilian Portuguese

Presentation of PLM

Supported programming languages

- Formerly a fat client
  - Written in Java

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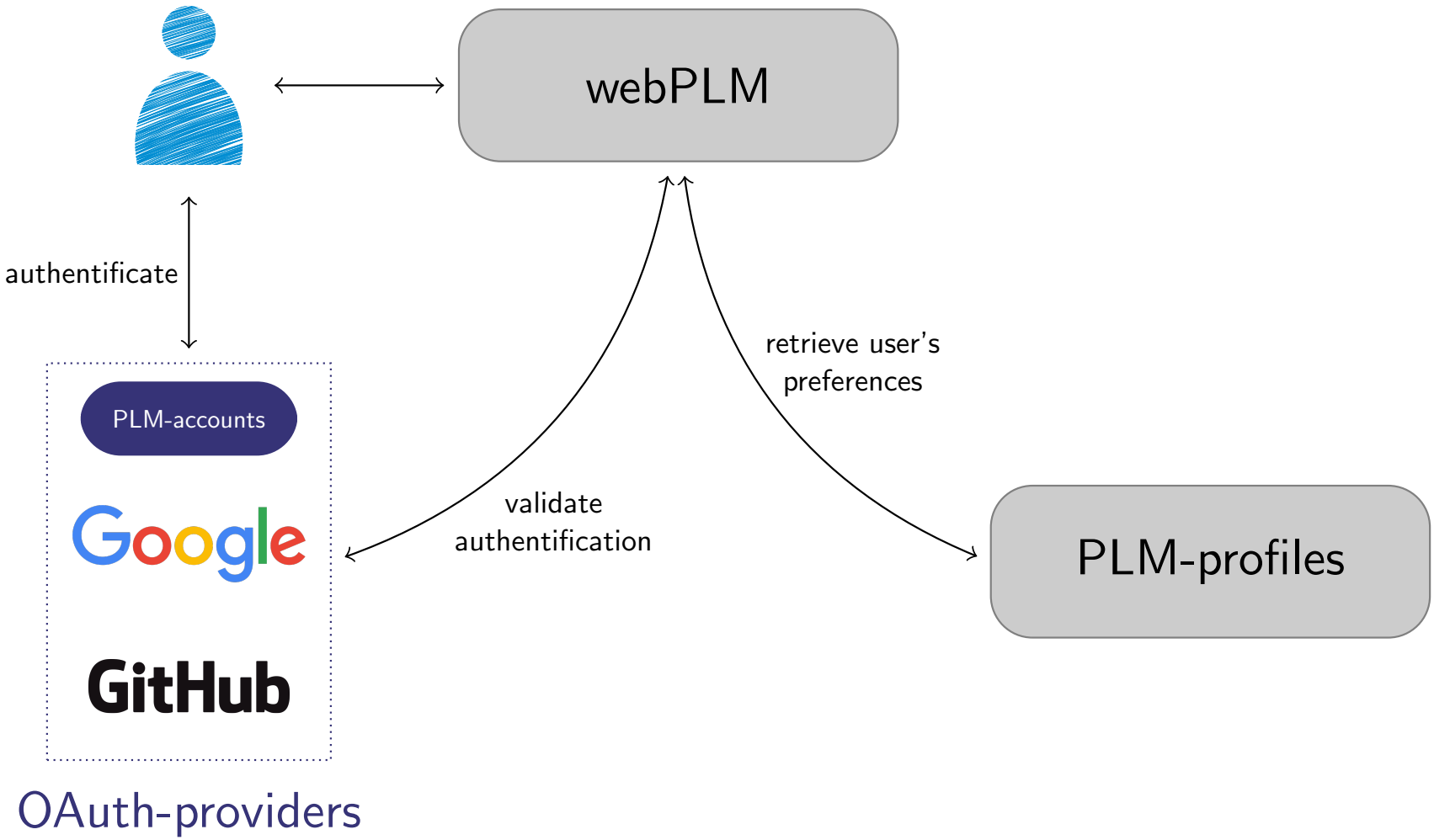
  - Written in Java
- Switch to a web application
  - Server implemented in Scala using PlayFramework
  - User interface written in Javascript using AngularJS and Foundation

Presentation of PLM

Application's architecture



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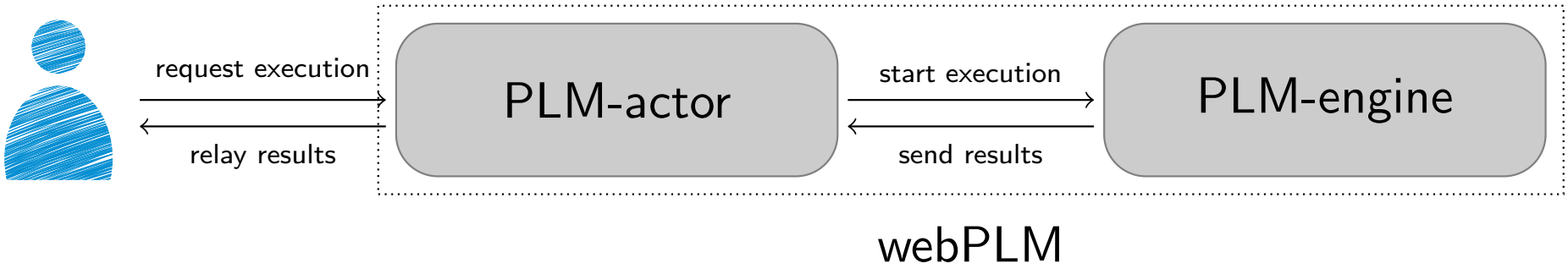
User's code's assessment

Execution components



User's code's assessment

Limits

- Run on the same machine, same JVM

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- And from more malicious "mistakes"?
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  - Storage jamming with files

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- And from *System.exit(whatever)*?

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- And from more malicious "mistakes"?
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  - Storage jamming with files
- And from *System.exit(whatever)*?
- Scalability issues

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Chosen solution

- Delegate the execution to workers
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  - Execute user's code and send back result to webPLM

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  - Prevent obvious issues with a security manager
  - Handle timeout and crash

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Chosen solution

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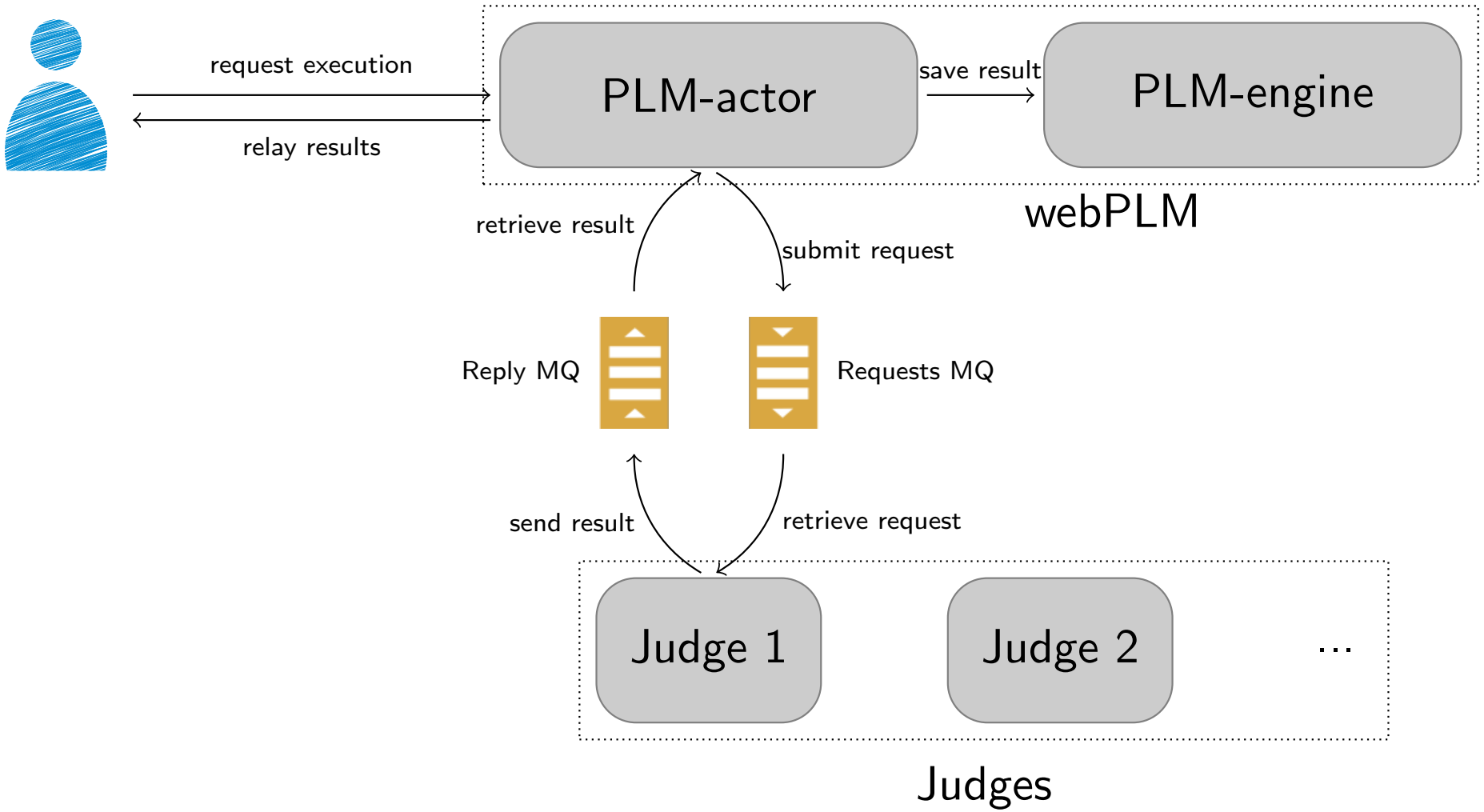
  - Called *Judges* in the litterature
  - Execute user's code and send back result to webPLM
- *Let it crash* strategy
  - Prevent obvious issues with a security manager
  - Handle timeout and crash
- Distribute workload using message queues
  - One queue for requests
  - One queue per result

User's code's assessment

Architecture with judges



User's code's assessment

- Pros:
  - Allow to run code without impacting webPLM's performances
  - Meet the scalability requirements

User's code's assessment

- Pros:
  - Allow to run code without impacting webPLM's performances
  - Meet the scalability requirements
- Cons:
  - Need to deploy them easily
  - Should be able to reset them
  - Have to restrict their resources usage

User's code's assessment

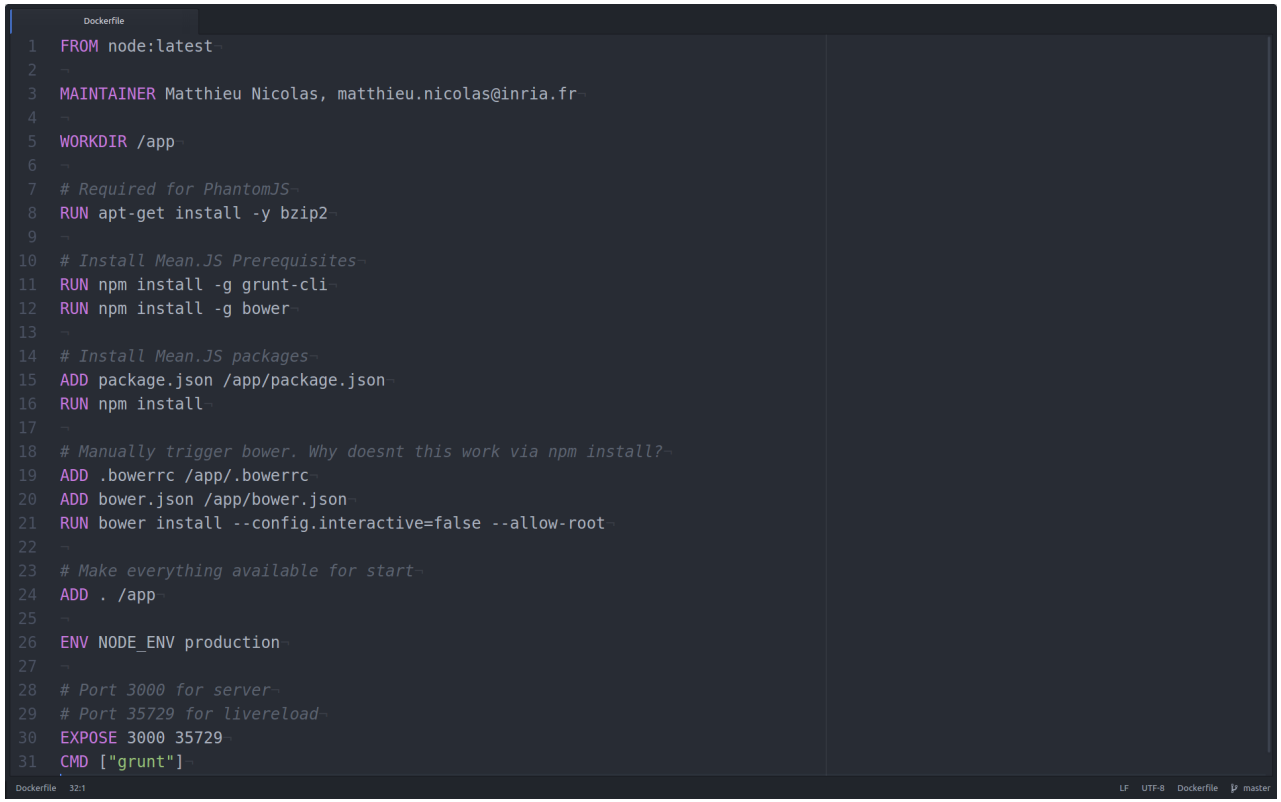
Docker

- Lightweight virtualization tool
- Build image of your application
- Run containers based on images

User's code's assessment

Example of Dockerfile

- Dockerfiles describe how to set up the application



```
Dockerfile
1  FROM node:latest
2
3  MAINTAINER Matthieu Nicolas, matthieu.nicolas@inria.fr
4
5  WORKDIR /app
6
7  # Required for PhantomJS
8  RUN apt-get install -y bzip2
9
10 # Install Mean.JS Prerequisites
11 RUN npm install -g grunt-cli
12 RUN npm install -g bower
13
14 # Install Mean.JS packages
15 ADD package.json /app/package.json
16 RUN npm install
17
18 # Manually trigger bower. Why doesnt this work via npm install?
19 ADD .bowerrc /app/.bowerrc
20 ADD bower.json /app/bower.json
21 RUN bower install --config.interactive=false --allow-root
22
23 # Make everything available for start
24 ADD . /app
25
26 ENV NODE_ENV production
27
28 # Port 3000 for server
29 # Port 35729 for livereload
30 EXPOSE 3000 35729
31 CMD ["grunt"]
Dockerfile 32:1                                LF UTF-8 Dockerfile master
```

- Run *docker build -t tag /path/to/Dockerfile* to build the image
- Start containers with *docker run tag*

User's code's assessment

More about *docker run*

- Can also manage
  - Ports

User's code's assessment

More about *docker run*

- Can also manage
  - Ports
  - Volumes

User's code's assessment

More about *docker run*

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  - Volumes
  - Links between containers

User's code's assessment

More about *docker run*

- Can also manage
  - Ports
  - Volumes
  - Links between containers
  - Environment variables
  - Runtime constraints on resources
  - Restart policies
  - And a **lot more**

User's code's assessment

More about *docker run*

- Can also manage
  - Ports
  - Volumes
  - Links between containers
  - Environment variables
  - Runtime constraints on resources
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  - And a **lot more**

- Commands can become quite complex

docker run -p 443:9443 -link plm-accounts:accounts -v ~/webPLM/logs/:/app/webplm-dist/logs webPLM

User's code's assessment

Docker-compose

- Tool to easily deploy multi-containers applications

```yaml
nginx:
  image: nginx
  ports:
    - "80:80"

messagequeue:
  image: rabbitmq:3-management
  ports:
    - "5672:5672"
    - "15672:15672"

plm:
  image: webplm
  volumes:
    - "~/.plm:/root/.plm"
    - "~/webPLM/logs/:/app/webplm-dist/logs"
  ports:
    - "443:9443"
  environment:
    GITHUB_CLIENT_SECRET:
    GOOGLE_CLIENT_SECRET:
    PLMACCOUNTS_CLIENT_SECRET:
    GITHUB_ACCESS_TOKEN:
  links:
    - accounts
    - profiles
    - messagequeue:messageq

accounts:
  image: plm-accounts
  environment:
    GITHUB_CLIENT_SECRET:
    GOOGLE_CLIENT_SECRET:
    PLMACCOUNTS_CLIENT_SECRET:
    GITHUB_ACCESS_TOKEN:
  links:
    - accounts
    - profiles
    - messagequeue:messageq

profiles:
  image: plm-profiles
  ports:
    - "8080:3000"
  links:
    - db

db:
  image: mongo
  volumes:
    - "~/mongodb/data:/data/db"
  ports:
    - "27017:27017"
```

- Deploy environment with *docker-compose up*

User's code's assessment

Docker in our case

- Deploy easily all components
- Restart judges automatically
- Limit users' mischiefs

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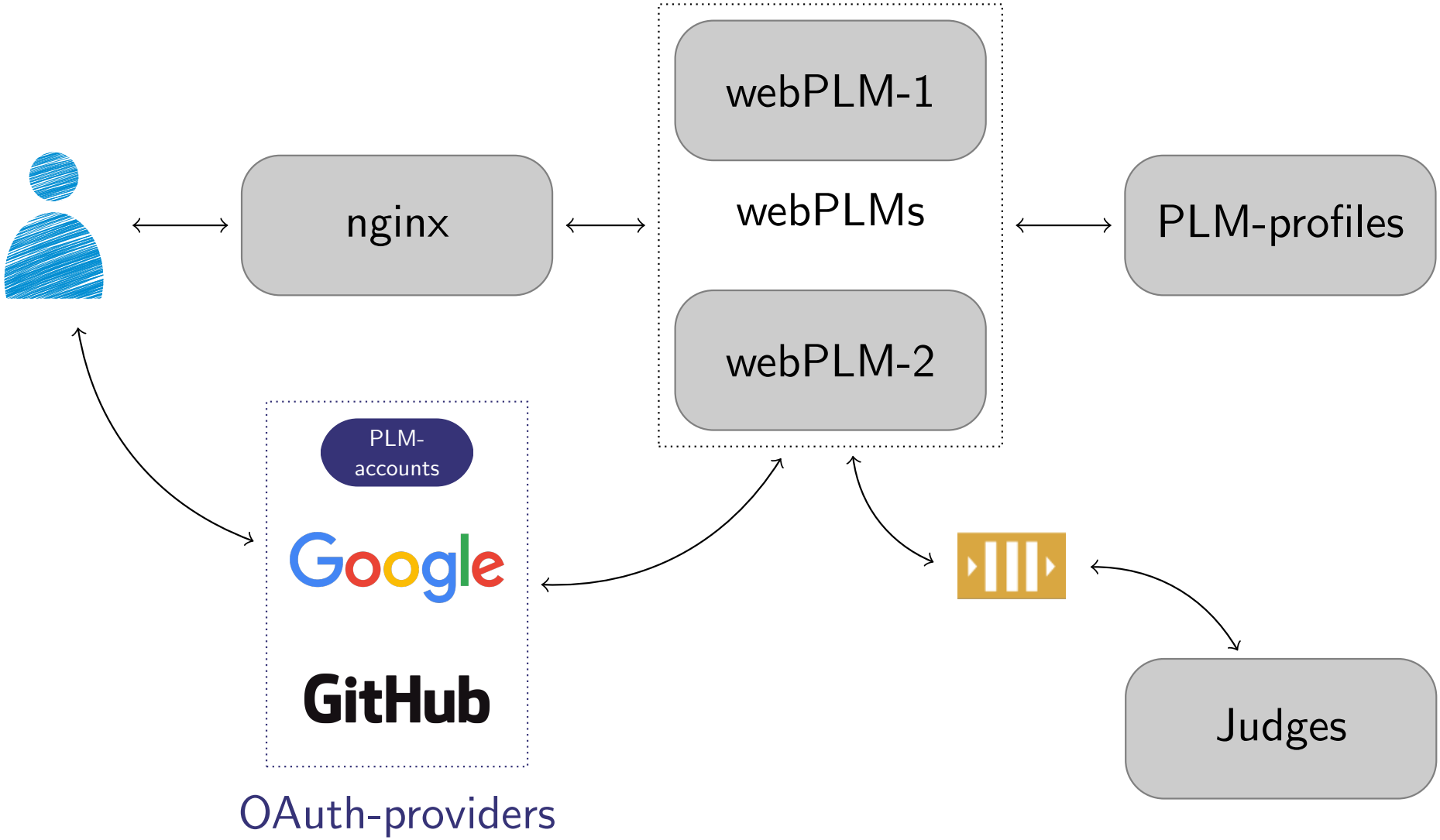
Result

Current architecture



Result

Live-session in TELECOM Nancy

- 30 hours of live testing with 100 students.

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- Engine is (almost) working fine...

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Live-session in TELECOM Nancy

- 30 hours of live testing with 100 students.
- Engine is (almost) working fine...
- ... but user experience needs to be improved!

Result

Live-session in TELECOM Nancy

- Can't cope with the workload.

Result

Live-session in TELECOM Nancy

- Can't cope with the workload.
- No tools for monitoring set up...

Result

Live-session in TELECOM Nancy

- Can't cope with the workload.
- No tools for monitoring set up...
- ... so the bottleneck is unknown.

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Next steps

Refactor the code

- Rushed to release a stable version before September...
- Needed to refactor some parts of the code.
- Standardized behavior of local and server mode.

Next steps

Simplify workflow to adapt the content

- Store most content inside PLM.
- Heavy and error prone workflow.
- Need to extract the content from PLM's jar.
- Allow to implement an exercise editor.

Next steps

Solve performance issues

- Set up some monitoring tools.
- Perform some load testing to identify the bottleneck.

Questions

Thanks for your attention, any questions?